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A comparison of collaborative and traditional instruction in higher education

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Abstract Although collaborative instructional techniques have become popular in college courses, it is unclear whether collaborative techniques can replace more traditional instructional methods. We examined the efficacy of collaborative courses (in-class, collaborative activities with no lectures) compared to traditional lecture courses (in-class, instructor-led presentations) in four sections of introductory psychology. Most other aspects of the courses remained constant, including the professor, assignments, and exams. The collaborative learning condition resulted in significantly lower quiz and exam scores in addition to lower self-reported satisfaction with the course and the instructor than the traditional lecture condition. Moreover, students were no more likely to be satisfied with the social environment in the collaborative condition. Our results suggest that collaborative techniques may be a way to enhance professorial lectures but should not be used to replace them entirely. Further research should explore the ratio of collaborative to traditional techniques that is most beneficial for college student learning.

Keywords College students · Collaborative learning · Traditional learning · Higher education

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1 Introduction

Successful collaborative learning features peers helping one another to solve problems in ways that could not be achieved through traditional instruction. The theoretical foundations of collaborative learning are well established (Johnson et al. 1991; Slavin 1996). Collaborative learning activities have been widely implemented in college classrooms where they are often integrated with traditional lecture techniques (Johnson et al. 2000). There are few controlled studies of collaborative learning (Delucchi 2007) and the published literature concentrates on correlational research in online environments (e.g., Barchard and Pace 2010; Hulbert-Williams 2010). Research studies on the efficacy of collaborative learning have shown mixed results. Inconsistent results may be accounted for by the degree to which instructors incorporate collaborative activities. While collaborative learning activities might be effective in moderation, it is unclear whether the effectiveness remains constant when the use of collaborative activities completely replaces traditional lecture methods. The present study tests the efficacy of an introductory psychology course that replaces traditional lectures with collaborative learning activities. We compare student learning and satisfaction in sections using collaborative activities with those using traditional lecture methods. While other research has established the efficacy of collaborative techniques when used in conjunction with lectures, our data will show whether it is effective to replace traditional lectures with collaborative activities.

1.1 Theories of collaborative learning

There are four theoretical explanations for the predicted efficacy behind collaborative learning (Johnson et al. 1991; Slavin 1996). The explanations are compatible and thus should be considered jointly (Slavin 1996). Each theoretical perspective suggests ways in which collaborative group structure and activities might be designed. These theoretical perspectives, while relatively simple, allow researchers to explain why a new technique might be effective or ineffective. Common collaborative techniques tend to correspond neatly to one or more of the various perspectives. To maximize success, the collaborative learning program in the present study was designed with elements of each theoretical stance.

The *Social Cohesion Perspective* sees students as motivated to help each other because they form relationships with one another and care about each other's well-being. Positive Interdependence Theory (Johnson et al. 1991) further specifies that students may unite around a common goal of mastery for each student in the group. This perspective predicts that the efficacy of collaborative learning will depend upon social cohesion in the group. Instructors adhering to this perspective strive to create long-term collaborative groups of individuals who are alike, have common goals, and thus can share "common ground" (Stahl 2005).

The *Cognitive Developmental Perspective* draws heavily on constructivist theory. It supposes that students achieve in collaborative groups because of cognitive conflict resolution. Group interaction gives individuals a platform to test their ideas. When an idea is revealed to the group, cognitive conflict arises as group members discuss the

pros and cons of the idea. Finally, conflict is resolved and clearer understanding of the topic emerges. Collaborative activities based on this model often involve explicit training in team skills and processes in order to specify how students are expected to go about communicating with one another (Hämäläinen and Arvaja 2009). Such "scripting" takes various forms but often involves assigning roles and ground rules for social engagement or an agenda for task completion.

The *Cognitive Elaboration Perspective* sees the benefits of collaborative learning as dependent upon students' elaborative rehearsal of the content material. Education researchers have repeatedly shown that teaching others is an effective way to learn and remember (Wittrock 1986). An example of a collaborative learning technique from this perspective is "reciprocal peer tutoring" in which students teach each other material by alternating in the roles of teacher and student (Fantuzzo et al. 1989).

Finally, the *Motivational Perspective* sees students as being driven to work together in order to obtain rewards. Motivational theorists suggest that it is important to carefully structure incentives such that group members' rewards are linked to the individual performance of others in the group. For example, an instructor might weight the grade on an exam as 80 % individual performance, whereas the remaining 20 % would be an average of each of the other collaborative group members' performance (Gokhale 1995). Alternatively, all group members could earn "bonus" points if each member of the group scores over a criterion level (Johnson et al. 1991). Because rewards (e.g., course points) depend on the performance of group members, individuals are motivated to help others in the group learn the material.

1.2 Research on collaborative learning

Research on collaborative learning methods in higher education has shown mixed results. Large scale meta-analyses have indicated that various forms of collaborative learning are effective at increasing measures of learning (Johnson et al. 2000; Springer et al. 1999). Descriptive research investigating student evaluations of collaborative learning has generally found that students like collaborative activities and feel as though they are useful (Barchard and Pace 2010; Gliddon and Rosengren 2012; Herron 2009; Hugh-Jones and Madill 2008). One controlled study (Gokhale 1995) found that critical thinking was enhanced by the use of collaborative strategies. In their review of efficacy research related to collaborative learning, Kirschner et al. (2008) suggested that learning outcomes are generally enhanced when collaborative learning activities use multiple scripting techniques (e.g., team strategies taught, roles assigned, students monitored). If collaborative activities can be effectively used to enhance learning, perhaps they could be used to replace traditional lecture techniques in college classes.

On the negative side, controlled research testing collaborative techniques has been rare. Two controlled studies found no effect of collaborative learning on factual knowledge of course material (Delucchi 2007; Gokhale 1995). Many other researchers report encountering problems in collaborative group processes such as uneven distribution of effort (Arvaja et al. 2007; Delucchi 2006; Hugh-Jones and Madill 2008; Kirschner et al. 2008; Lin and Tsai 2012), stress (Jung et al. 2012), and interpersonal difficulties (Barron 2000). The research shows that effective collaborative learning requires more

than simply forming groups and assigning tasks (Hämäläinen and Arvaja 2009). There is a variety of techniques that are referred to as collaborative, some of which may be more successful than others. Moreover, since collaborative learning is generally used as in conjunction with traditional techniques, it is unclear to what extent the use of collaborative techniques is beneficial. It may be the case that overuse of collaborative learning techniques has an adverse effect on student learning. The published studies do not address the optimal amount of collaborative course activities and often suggest that traditional lecture techniques are inferior to collaborative learning (Yadin and Or-Bach 2010).

Our research examined the efficacy of an introductory psychology class taught using collaborative learning techniques in place of instructor-led lecture. This condition was compared to a control group consisting of a class taught using traditional lecture techniques with no collaboration. The collaborative activities in our study were designed to incorporate all four theoretical perspectives (Johnson et al. 1991; Slavin 1996). We hypothesized that, when compared to traditional lecture-based methods, collaborative learning would produce (1) improved academic performance in the class, and (2) greater student satisfaction with the class, the instructor, and the social experience of the class.

2 Method

Research participants were drawn from four sections of introductory psychology taught by the same instructor at a public, open-admissions university. At the start of the study, there were 141 students enrolled in the four sections. After the deadline to drop classes, 98 student participants remained. Two sections were taught as the Traditional Lecture (TL) control condition ($n = 47$) and two sections were taught as the Collaborative Learning (CL) experimental condition ($n = 51$). Although we were unable to randomly assign students to conditions, we did randomly assign course sections to the TL or CL conditions. TL sections met at 10:00 a.m. and 2:00 p.m. CL sections met at 9:00 a.m. and 12:00 p.m. All sections met MWF. Data collection took place between the start of the Spring 2011 semester through midterm.

For students in the TL condition, the 50-min class period consisted entirely of lecture (with the only exception being exam days). Although students interacted with the instructor during lecture, students did not typically interact with one another during class since there were no course activities structured around student interaction. Students in the CL condition were assigned to groups of four. These groups used the entire 50-min class period for scripted collaborative activities (with the only exception being exam days). To enhance validity of the CL manipulation and maximize the benefits of the collaborative learning experience, CL activities were designed to reflect the four theoretical perspectives (Johnson et al. 1991; Slavin 1996). A description of the activities related to each perspective follows.

The Social Cohesion Perspective (Slavin 1996) predicts that the creation of long-term, stable groups will result in members forming interpersonal bonds and becoming motivated to help one another. In the CL condition, we formed groups on the first class meeting with the explicit goal of each member gaining mastery over the course

material. With few exceptions (e.g., a member dropping the course), group membership remained the same over the course of the study.

The Cognitive Developmental Perspective (Slavin 1996) predicts that students challenging one another during discussions will help the group arrive at a better understanding of the material than what members might achieve on their own. The CL condition was given a scripted Application Assignment to encourage this type of discussion. This daily (25 min), in-class, critical-thinking assignment was designed to allow students to use course concepts in a novel situation. For example, students might be asked to give an example of a profession in which someone might use the concept (e.g., operant conditioning) and explain how he/she would use the concept to his/her benefit. Students were instructed that conflict was a necessary part of the Application Assignment. They were told to point out the pros and cons in each other's ideas until the group came up with an answer with which they all felt confident.

The Cognitive Elaboration Perspective (Slavin 1996) predicts that students will benefit from teaching one another by repeatedly reviewing the material. The CL condition's Focus on Objectives Assignment was designed to maximize cognitive elaboration. In preparation for this daily (25 min.), in-class assignment, students independently completed homework which involved writing out two to three learning objectives (e.g., Describe the DSM IV-TR and discuss the costs and benefits of diagnostic labeling). In class, students compared their answers aloud, corrected any misunderstandings, and tested one another on their understanding of the objectives.

The Motivational Perspective (Slavin 1996) predicts that creating an interdependent reward structure will encourage group members to help one other learn. To emphasize the motivational perspective, the CL condition had the opportunity to earn "Group Rewards." Group Rewards consisted of bonus points awarded to group members if every member could individually demonstrate proficiency with the material by scoring a grade of 80 % or over on an exam.

Apart from the manipulation outlined previously, every effort was made to control variability between the TL and CL conditions. Students in both groups were given a set of daily objectives which explicitly corresponded to all class activities (e.g., reading assignments, quizzes, and exams). Both groups used the same assessments, textbook, and online resources (which included PowerPoint slides with prerecorded audio lectures). The TL group was given the same number of bonus points as the CL group based on their answers to a bonus essay question on the exam. The homework portion of the CL group's Focus on Objectives assignment was completed independently by students in the TL group. Both groups adhered to the same absence policy which specified that unexcused absences would result in a zero grade for the daily assignment or exam that was missed.

Dependent measures focused on student learning and satisfaction with the course. Learning outcome measures included scores on 16 written homework assignments (5-point scale), 16 online quizzes (5-item, multiple-choice) and 2 unit exams (40-item, multiple-choice). Student satisfaction was measured using a 5-point student evaluation of the class (4 items; e.g., "I am satisfied with this course" Cronbach's alpha = .82) and the instructor (4 items; e.g., "Instructor structures material in a way the helps me learn," alpha = .88). We also measured students' comfort level with the social experience of class (6, 5-point questions; e.g., "I feel at ease participating in this course," alpha =

.84) and student completion of text reading (self-reported percentage of text read). To check for equivalence between conditions, we administered a 100-point pretest of course knowledge on the first day of class.

3 Results

Initial data analyses focused on establishing the equivalence of conditions. Because we did not randomly assign participants to conditions, there was a risk that our groups differed prior to the onset of the manipulation. To ensure equivalence of participants in the two conditions, we compared pretest scores. Pretest scores were generally low in both groups (CL$M = 35.32$, $SD = 11.32$; TL$M = 35.50$, $SD = 9.32$) and there was no significant difference between groups, $t(69) = -.07,\ p = .94, \eta p^2 = .00$). We also surmised that differences in groups could occur erroneously if one group had a higher attrition rate than the other. Therefore, we performed a chi square test on course attrition. The CL condition lost 19 of 70 students over the study period and the TL condition lost 24 of 71 students. The difference was not significant ($p = .83$). Finally, we evaluated the self-reported completion of assigned textbook reading. There were no significant differences between groups ($t_{89} = .03,\ p = .98, \eta p^2 = .00$) with students in each group reporting that they completed approximately 76 % of the assigned reading.

Our first hypothesis predicted that, when compared to traditional lecture (TL) methods, collaborative learning (CL) would produce improved student academic performance. Contrary to the hypothesis, we found that students in the CL condition ($M = 64.51\,\%$, $SD = 15.58$) scored significantly lower on online quizzes than those in the TL condition ($M = 74.93\,\%$, $SD = 11.02$), $t_{90} = -3.07,\ p = .03, \eta p^2 = .09$. Similarly, CL students ($M = 62.37\,\%$, $SD = 17.70$) scored lower on unit exams than TL students ($M = 74.23\,\%$, $SD = 14.85$), $t_{96} = -3.72$, $p = .001$, $\eta p^2 = .13$. There was no statistically significant difference between CL and TL groups on scores for the homework assignments, $t_{94} = -1.73,\ p = .09, \eta p^2 = .03$.

Our second hypothesis predicted that students in the CL condition would report greater satisfaction with the class, the instructor, and the social experience than those in the TL condition. This hypothesis was contradicted. Students in the TL condition ($M = 4.39/5.00$, $SD = .52$) reported significantly greater satisfaction with the class than those in the CL condition ($M = 4.01$, $SD = .75$), $t_{89} = -2.92$, $p = .001$, $\eta p^2 = .08$. We found a similar pattern in instructor evaluation with TL students ($M = 4.81/5.00$, $SD = .29$) liking the instructor more than CL students ($M = 4.43$, $SD = .55$), $t_{77} = -4.35$, $p = .001$, $\eta p^2 = .16$. We found no statistically significant difference between the evaluations of the social environment in the two conditions, $t_{95} = -.15,\ p = .88, \eta p^2 = .00$. Students were fairly satisfied with the social environment in both conditions (CL$M = 4.04/5.00$, $SD = .57$; TL$M = 4.05/5.00$, $SD = .60$).

4 Discussion

Our research sought to test whether structuring an introductory psychology course focused on using in-class collaborative learning techniques might be useful. We

designed an experimental course that incorporated the four major theoretical perspectives on collaborative learning (Slavin 1996) and included no instructor lectures. When compared to a traditional lecture (TL) course, the collaborative learning (CL) course adversely affected student learning and satisfaction with the course. There are several limitations to our study and additional controlled research testing the varying degrees and techniques of collaborative learning in college courses needs to be completed before firm conclusions can be drawn. However, our findings suggest that instructors should be encouraged to use collaborative learning in conjunction with lecture methods, rather than replacing lectures, in college courses.

Contrary to our expectations, students in the CL condition had lower quiz and exam scores than those in the TL condition, indicating that students were having difficulty learning the course content without some traditional lectures. Our findings concur with research suggesting that traditional instruction should be seen as complementary, rather than inferior to collaborative learning (Yadin and Or-Bach 2010). Our initial plans were to carry out our study for the entire semester. However, data indicating that students in our CL condition were at a disadvantage caused us to halt the study at midterm for ethical reasons. If we had continued the research to the end of the semester, the outcome might have been different, as students in the CL condition might have had more time to adjust to the collaborative activities. A limited time period may have compromised student ability to form the social bonds suggested by the social cohesion perspective, or learn how to manage conflict constructively as suggested by the cognitive developmental perspective (Slavin 1996). Another possibility is that one of the CL techniques might have been useful, but was cancelled out by another technique that was detrimental.

Similar to measures of student learning, measures of student satisfaction were lower in the CL condition than the TL condition. Specifically, CL students reported lower satisfaction with the course and the instructor. Lowered satisfaction in the CL condition may have resulted from the problem of a large proportion of the students being unprepared for class. Unprepared students in the CL condition were immediately apparent to group members and the instructor, unlike the TL condition, in which student preparation could remain relatively unnoticed. Other contributors to lower satisfaction in the CL condition may include lower grades and conflicts with group members. Several students complained that they contributed more work effort than their group members. Despite the statistically significant differences between conditions, an examination of the means shows that our students were generally satisfied with both conditions. Had we not included the TL control condition, we certainly would have concluded, as other authors have (Barchard and Pace 2010; Herron 2009; Hugh-Jones and Madill 2008), that students were satisfied with collaborative learning.

5 Limitations and conclusion

Our study has several limitations. The first concerns our participant population. Perhaps more academically-prepared upper-classmen may have the skills to better equip them for the collaborative environment. Further scripting of appropriate course participation and policies designed to improve course participation may have also been

of value. As an added control, we should have tracked the use of online materials to evaluate whether their use differed between the CL and TL conditions. Our Group Rewards may have been too difficult to attain and therefore lacked a motivating influence since only one CL group earned these points. Another limitation concerns the lack of a manipulation check to monitor whether collaboration was taking place as planned in the CL condition. Ideally, observational data would be necessary to gauge the extent to which students are building social cohesion, engaging in constructive conflict, and motivating and teaching one another. Finally, experimenter bias could have been a problem. One of the experimenters was also the instructor for all of the courses, and was not blind to conditions. Despite these limitations, our study contributes to a relatively small body of literature that has used controlled designs to test collaborative learning in the college classroom. Our data on student learning suggest that collaborative techniques may be a way to enhance professorial lectures but should not be used to replace them entirely. Controlled demonstrations of the efficacy of teaching techniques are especially important in light of recent, well publicized findings showing that over one-third of college students show no significant gains in learning over four years of college (Arum and Roksa 2011). Future research should consider using controlled studies to measure varying proportions of collaborative and traditional techniques in an attempt to find an optimal balance between the two forms of teaching.

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